

Syllabus for
MAT 221—Mathematics Concepts I
3 Credit Hours
Fall 2012

I. COURSE DESCRIPTION

A study of the underlying theory of elementary mathematical topics, including problem-solving, sets, numeration, computational algorithms, number theory ratio, proportion, percent, real numbers, and introductory algebra. (Does not count toward a major or minor in mathematics.)
Prerequisite: MAT 151.

II. COURSE GOALS

The purpose of this course is to enable the student to be able to do the following:

- A. Understand the mathematical background necessary to teach the mathematical content in the first through eighth grades.
- B. Gain an appreciation for the beauty and usefulness of mathematics.
- C. Utilize Polya's four-step problem-solving framework and a variety of strategies in solving problems.
- D. Perform basic operations on sets.
- E. Interpret or write numerals in other bases.
- F. Identify and utilize functions.
- G. Perform basic operations with whole numbers, fractions, decimals, and integers using paper and pencil algorithms, mental algorithms, and calculators
- H. Calculate the prime factorization, greatest common factor, and least common multiple of given whole numbers.

III. STUDENT LEARNING OUTCOMES FOR THIS COURSE

A. Terminal Objectives

As a result of successfully completing this course the student will be able to do the following:

- 1. Identify and apply problem-solving strategies to real world problems.
- 2. Use Polya's four step problem-solving process.
- 3. Explain the validity of arguments using logic and logical connections.
- 4. Perform operations on sets.
- 5. Relate the Hindu-Arabic number system to other ancient systems and other number bases.
- 6. Illustrate models for whole number operations.
- 7. Solve whole number computation problems using proper algorithms.
- 8. Apply mental math techniques.
- 9. Perform calculations involving clock arithmetic.

10. Apply number theory concepts to number computation.
11. Compute with rational numbers.
12. Translate decimals, percent, and fractions.
13. Solve problems using ratios, proportions, and percents.
14. Calculate sums, differences, products, and quotients with integers.
15. Apply the properties of exponents to the set of real numbers.

B. Unit Objectives

1. Unit 1: Problem Solving

As a result of successfully completing this unit, the student will be able to do the following:

- a. Give a general definition of problem solving in mathematics.
- b. Explain, illustrate, and use Polya's 4-step problem solving process.
- c. Explain, illustrate, and apply problem-solving strategies.
- d. Identify terms and patterns of arithmetic and geometric sequences.
- e. Apply algebra in solving problems.
- f. Investigate the validity of logic arguments.
- g. Write statements in logic symbolic form.
- h. Explain the truth value and construct a truth table for a statement.
- i. Write the converse, inverse, and contrapositive for a statement.

2. Unit 2: Whole numbers and Functions

As a result of successfully completing this unit, the student will be able to do the following:

- a. Describe the concept of set and use set notation.
- b. Illustrate the Cartesian product.
- c. Demonstrate a 1-1 correspondence.
- d. Explain whether a relation is reflexive, symmetric, and/or transitive.
- e. Explain whether a relation is an equivalence relation.
- f. State the definition of the domain, range, and codomain of a function.
- g. Describe the concept of function.
- h. Represent functions in many ways.
- i. Represent addition of whole numbers using a set model and a number line model.
- j. Justify and apply properties for addition and multiplication of whole numbers.
- k. Explain, illustrate, and use thinking strategies for learning basic addition facts.
- l. Represent subtraction of whole numbers using the take-away, missing addend, and comparison approaches.
- m. Explain how to obtain basic subtraction facts from addition facts using the missing addend approach.
- n. Describe multiplication of whole numbers using repeated addition, Cartesian product, and rectangular array approaches.
- o. Explain, illustrate, and use thinking strategies for learning basic multiplication facts.
- p. Represent division of whole numbers using the missing factor approach, the partition model, and the repeated subtraction approach.
- q. Explain how to obtain basic division facts from multiplication facts using the missing factor approach.

- r. Explain division problems involving zero using the missing factor approach.
 - s. State the division algorithm and illustrate it using examples on the number line.
 - t. Describe less than and greater than with whole numbers using the operation of addition.
 - u. Justify and apply the properties of less than.
 - v. State the definition of whole number exponents using repeated multiplication.
3. Unit 3: Whole Number Computation
- As a result of successfully completing this unit, the student will be able to do the following:
- a. Give examples of and contrast mental, electronic, and written algorithms.
 - b. Identify and apply the mental math techniques.
 - c. Identify and apply estimation techniques.
 - d. Express whole numbers and compare attributes of different numeration systems.
 - e. Describe scientific notation as it appears on scientific calculators.
 - f. Justify the standard addition and subtraction algorithm using concrete models (e.g., multibase pieces and a chip abacus) and place value and properties of addition.
 - g. Explain, illustrate, and use the intermediate algorithms for addition that lead to the standard algorithm and the lattice method for addition.
 - h. Explain, illustrate, and use nontraditional algorithms for subtraction.
 - i. Justify the standard multiplication and long division algorithms using place value and properties of multiplication.
 - j. Explain, illustrate, and use intermediate algorithms that lead to the standard multiplication algorithm and the lattice method for multiplication.
 - k. Explain, illustrate, and use long division algorithms (including the scaffold method) that lead to the standard algorithm.
 - l. Add, subtract, multiply, and divide in bases 2 through 12.
4. Unit 4: Number Theory
- As a result of successfully completing this unit, the student will be able to do the following:
- a. Identify prime and composite numbers.
 - b. State and apply the fundamental theorem of arithmetic.
 - c. State and apply tests for divisibility by 2, 3, 4, 5, 6, 8, 9, 10, 11, and 12.
 - d. Find the prime factorization of a given composite number.
 - e. Use the prime factorization of a number or find all of its factors.
 - f. Use the exponents in the prime factorization of a number to count its factors.
 - g. Find the GCD and LCM of a given pair of numbers using the set intersection method, the prime factorization method, and the Euclidean algorithm.
 - h. Relate the GCD and LCM of any two numbers to the product of the numbers.
 - i. Define and apply modular arithmetic.
 - j. State the definition of the set of integers.

- k. Represent integers using colored chips and on the integer number line.
 - l. Explain how to add integers via the chip or number line model.
 - m. Define addition of integers via whole numbers and opposites.
 - n. Explain and apply the properties of integer addition.
 - o. Apply the order of operations.
 - p. Explain how to subtract pairs of integers using different approaches.
 - q. Distinguish between the terms “negative,” “opposite,” and “minus.”
 - r. Explain how to represent multiplication of integers using repeated addition, patterns, and concrete models.
 - s. Define multiplication of integers through a variety of models.
 - t. Define and apply the distributive property of integer multiplication over addition and subtraction.
 - u. Explain and apply the properties of integer multiplication.
 - v. Explain division of integers.
 - w. Calculate if a given sum, difference, product, or quotient of integers is positive, negative, zero, or undefined.
 - x. State the definition of less than and greater than for integers.
5. Unit 5: Rational Numbers
- As a result of successfully completing this unit, the student will be able to do the following:
- a. State the definition of a fraction as a numeral that represents part of a whole and sketch pictures that illustrate given fractions.
 - b. State the definition of a fraction as a number that represents relative amounts and sketch pictures all of which represent the same relative amounts and, hence, are represented by the same fraction (as a number).
 - c. Express a fraction in its simplest form.
 - d. Show how to compare fractions using common denominators.
 - e. State and apply the cross multiplication property of inequality.
 - f. State the definition of density and apply it to any given pair of fractions.
 - g. Show how to motivate the definition of addition, subtraction, multiplication, and division using concrete models.
 - h. Compute sums, products, differences, and quotients of given pairs of fractions and provide rationale for the computations.
 - i. Describe the three equivalent ways to find the quotient of two fractions.
 - j. State the definitions of multiplicative inverse and reciprocal.
 - k. Demonstrate which of the properties of addition and multiplication hold for fractions.
 - l. Use mental math/estimation techniques for fractions.
 - m. Justify and apply the properties of exponents.
 - n. Use rates to compare quantities.
6. Unit 6: Decimals, Ratio, Proportion, and Percents
- As a result of successfully completing this unit, the student will be able to do the following:
- a. Show how to represent decimals using base ten blocks.
 - b. Write a given decimal numeral in expanded form.
 - c. Translate decimal numerals into their word names and vice versa.
 - d. Characterize the fractions with terminating decimal representations.
 - e. Order decimals using various representations.
 - f. Justify “moving the decimal point” when multiplying or dividing by a power of 10 or using scientific notation.
 - g. Estimate the sum, difference, product, and quotient of pairs of decimals.

- h. Compute sums, differences, products, and quotients of numbers in decimal form using standard algorithms and a calculator.
- i. Demonstrate that terminating decimals are a numeration system for certain fractions by changing these fractions to decimals and vice versa.
- j. Change any fraction to its decimal form.
- k. Convert given repeating decimals to their fraction form and characterize the fractions that have repeating, nonterminating decimal representations.
- l. Identify irrational numbers.
- m. Compute square roots.
- n. Define the set of real numbers and summarize its properties.
- o. Define $n\%$ (n percent) for any fraction and solve problems involving percent.
- p. Convert any fraction, decimal, or percent into any of the other two forms.
- q. Solve applied problems involving ratios, proportions, and percents.
- r. Compute rational exponents with and without calculators.

C. Objectives for Students in Teacher Preparation Programs

The Teacher Preparation Program meets the competency-based requirements established by the Oklahoma Commission on Teacher Preparation. This course meets the following competencies: Elementary Mathematics Subject Competencies (SC) 4-7.

- SC 4: Has a broad and deep knowledge of the concepts, principles, techniques, and reasoning methods of mathematics that are used to set curricular goals and shape teaching.
- SC 5: Understands significant connections among mathematical ideas and the applications of these ideas to problem solving in mathematics, in other disciplines, and in the world outside of school.
- SC 6: Has experiences with practical applications of mathematical ideas.
- SC 7: Is proficient in, at least, the mathematics content needed to teach the mathematics skills described in Oklahoma's core curriculum, from multiple perspectives. This includes, but is not limited to, a concrete and abstract understanding of number systems and number sense, functions, and algebra necessary to effectively teach the mathematics content skills addressed in the first through eighth grade as well as the mathematics process skills of problem-solving, reasoning, communication, and connections.

IV. TEXTBOOKS AND OTHER LEARNING RESOURCES

A. Required Materials

- 1. Textbooks

Billstein, Rick, Shlomo Libeskind, and Johnny W. Lott. *A Problem Solving Approach to Mathematics for Elementary School Teachers*. 10th ed. Boston: Pearson Education, 2010. ISBN-13: 978-0-321-57055-0

A *MyMathLab* packet access code may be packaged with the textbook. The student also has the option to purchase a separate *MyMathLab* packet in order to be able to complete the homework assignments. The *MyMathLab* packet includes an online version of the textbook. ISBN-12: 9780321199911

2. Other
Scientific calculator
- B. Optional Materials
1. Textbooks
None
 2. Other
None

V. POLICIES AND PROCEDURES

A. University Policies and Procedures

1. Attendance at each class or laboratory is mandatory at Oral Roberts University. Excessive absences can reduce a student's grade or deny credit for the course.
2. Students taking a late exam because of an unauthorized absence are charged a late exam fee.
3. Students and faculty at Oral Roberts University must adhere to all laws addressing the ethical use of others' materials, whether it is in the form of print, electronic, video, multimedia, or computer software. Plagiarism and other forms of cheating involve both lying and stealing and are violations of ORU's Honor Code: "I will not cheat or plagiarize; I will do my own academic work and will not inappropriately collaborate with other students on assignments." Plagiarism is usually defined as copying someone else's ideas, words, or sentence structure and submitting them as one's own. Other forms of academic dishonesty include (but are not limited to) the following:
 - a. Submitting another's work as one's own or colluding with someone else and submitting that work as though it were his or hers;
 - b. Failing to meet group assignment or project requirements while claiming to have done so;
 - c. Failing to cite sources used in a paper;
 - d. Creating results for experiments, observations, interviews, or projects that were not done;
 - e. Receiving or giving unauthorized help on assignments.

By submitting an assignment in any form, the student gives permission for the assignment to be checked for plagiarism, either by submitting the work for electronic verification or by other means. Penalties for any of the above infractions may result in disciplinary action including failing the assignment or failing the course or expulsion from the University, as determined by department and University guidelines.
4. Final exams cannot be given before their scheduled times. Students need to check the final exam schedule before planning return flights or other events at the end of the semester.
5. Students are to be in compliance with University, school, and departmental policies regarding Whole Person Assessment (WPA) requirements. Students should consult the WPA handbooks for requirements regarding general education and the students' majors.
 - a. The penalty for not submitting electronically or for incorrectly submitting an artifact is a zero for that assignment.
 - b. By submitting an assignment, the student gives permission for the assignment to be assessed electronically.

- B. Department Policies and Procedures
1. Each Student who uses the computer is given access to the appropriate computer resources. These limited resources and privileges are given to allow students to perform course assignments. Abuse of these privileges will result in their curtailment. Students should note that the contents of computer directories are subject to review by instructors and the computer administrative staff.
 2. A fee of \$15.00 will be assessed for all late exams. This policy applies to all exams taken without notifying the professor prior to the regularly scheduled exam time, and to all exams taken late without an administrative excuse.
 3. Any student whose unexcused absences total 33% or more of the total number of class sessions will receive an F for the course grade.
- C. Course Policies and Procedures
1. Evaluation Procedures
 - a. Grading procedures:

3 Unit Examinations	100 pts. each
Project	50 pts.
Ongoing Assessment Problems	100 pts.
Quizzes/Discussion Boards	50 pts.
<u>Final Exam</u>	<u>150 pts.</u>
Total	650 pts.
 - b. The standard grading scale will be used:
 - A=90%
 - B=80%
 - C=70%
 - D=60%
 - F=59% and below

A grade of C is required to pass this course.
 2. Whole Person Assessment Requirements

None
 3. Other Policies and/or Procedures
 - a. All daily assignments are facilitated through coursecompass.com. Students are required to purchase access to this program in order to complete the homework assignments for each exaction. If a student feels the need for additional practice after completing the *MyMathLab* homework assignment, then he or she can use additional problems from the text chapters.
 - b. Problems or projects will be assigned at most classes. These are due at the beginning of the next class unless it is indicated to the contrary at the time the assignment is made. The instructor does not have to except late work.
 - c. Regular quizzes may be given over the exercise/problem sets. It is the student's responsibility to make-up missed quizzes during the instructor's office hours.

VI. COURSE CALENDAR

Lesson	Text	Topic
1		Introduction
2	1.1	Math and Problem Solving
3	1.2	Explorations with Patterns
4-5	1.3	Logic
6	2.1	Numeration Systems
7	2.2	Describing Sets
8	2.3	Other Set Operations & Properties
9	3.1	Add & Subtract of Whole Numbers
10	3.2	Algorithms for Whole Numbers A&S
11	3.3	Mult. And Division of Whole Numbers
12	3.4	Algorithms for Whole Numbers M&D
13	3.5	Mental Math
14		Review
15		TEST 1 Chapters 1-3
16	4.1	Variables
17	4.2	Equations
18	4.3	Functions
19	5.1	Integers, Add & Subtract
20	5.2	Integers, Multiply & Divide
21	5.3	Divisibility
22	5.4	Prime & Composite Numbers
23	5.5	GCD & LCM
24	5.6	Clock & Modular Arithmetic
25		Review
26		TEST 2 Chapters 4-5
27	6.1	Rational Numbers
28	6.2	Rationals, Add & Subtract
29	6.3	Rationals, Multiply & Divide
30	7.1	Introduction to Decimals
31	7.2	Operations on Decimals
32	7.3	Nonterminating Decimals
33	7.4	Real Numbers
34	7.5	Real Numbers in Equations
		Review
		TEST 3 Chapters 6-7
		Final Exam Review
		COMPREHENSIVE FINAL EXAM

Course Inventory for ORU's Student Learning Outcomes
MAT 221—Mathematics Concepts I
Fall 2012

This course contributes to the ORU student learning outcomes as indicated below:

Significant Contribution – Addresses the outcome directly and includes targeted assessment.

Moderate Contribution – Addresses the outcome directly or indirectly and includes some assessment.

Minimal Contribution – Addresses the outcome indirectly and includes little or no assessment.

No Contribution – Does not address the outcome.

The Student Learning Glossary at <http://ir.oru.edu/doc/glossary.pdf> defines each outcome and each of the proficiencies/capacities.

OUTCOMES & Proficiencies/Capacities		Significant Contribution	Moderate Contribution	Minimal Contribution	No Contribution
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1	Outcome #1 – Spiritually Alive Proficiencies/Capacities				
1A	Biblical knowledge				X
1B	Sensitivity to the Holy Spirit				X
1C	Evangelistic capability				X
1D	Ethical behavior		X		

2	Outcome #2 – Intellectually Alert Proficiencies/Capacities				
2A	Critical thinking	X			
2B	Information literacy				X
2C	Global & historical perspectives			X	
2D	Aesthetic appreciation			X	
2E	Intellectual creativity		X		

3	Outcome #3 – Physically Disciplined Proficiencies/Capacities				
3A	Healthy lifestyle				X
3B	Physically disciplined lifestyle				X

4	Outcome #4 – Socially Adept Proficiencies/Capacities				
4A	Communication skills		X		
4B	Interpersonal skills		X		
4C	Appreciation of cultural & linguistic differences			X	
4D	Responsible citizenship			X	
4E	Leadership capacity			X	

